**DEPARTMENT OF COMPUTER SCIENCE &  ENGINEERING, NITK – Surathkal**

# CS204: Data Structures and Algorithms Lab

## LAB - 3

28th September 2021

**Instructions:**
1. Implement the following exercise using C.
2. Read inputs from a file and also print the outputs to a file.
3. You are required to complete this exercise by the next lab.
4. Submit all the programs in a single  .zip file.

**Exercise:**

1. Write a program for memory mapping a 2D array into a 1D array using:
   a. Row-major order
   b. Column-major order

   | Sample Input: | Sample Output: |
   |---|---|
   | 1 2 3 | Row-major: 1 2 3 4 5 6 7 8 9 |
   | 4 5 6 | Column-major: 1 4 7 2 5 8 3 6 9 |
   | 7 8 9 | |

2. Write a program for memory mapping lower and upper triangular 2D arrays into 1D arrays using
   a. Row-major order
   b. Column-major order

   | Sample Input (upper triangular): | Sample Output: |
   |---|---|
   | 1 2 3 | Row-major order: 1 2 3 4 5 6 |
   | 0 4 5 | Column-major order: 1 2 4 3 5 6 |
   | 0 0 6 | |

3. Write a program for memory mapping a sparse 2D array into a 1D array using (row index, column index, value).

4. Write a program for memory mapping a symmetric 2D array into a 1D array using:
   a. Row-major order
   b. Column-major order

Sample Input:                          Sample Output:
1 2 3                                  Row-major: 1 2 3 5 6 9
2 5 6                                             1 2 5 3 6 9
3 6 9                                  Column-major: 1 2 5 3 6 9
                                                  1 2 3 5 6 9

5. Write a program for memory mapping a tridiagonal 2D array into a 1D array using.
    a. Row-major order
    b. Column-major order
    c. Diagonal-wise

Sample Input (upper triangular):      Sample Output:
1 2 0 0                                Row-major order: 1 2 3 4 5 6 7 8 9 1
3 4 5 0                                Column-major order: 1 3 2 4 6 5 7 9 8 1
0 6 7 8                                Diagonal-wise: 3 6 9 1 4 7 1 2 5 8
0 0 9 1

6. Write a recursive program to solve the tower of Hanoi problem where we have three rods (A, B, C) and n disks. The disks are of different sizes and placed on the rod A in ascending order of their size, i.e. the smaller ones are placed over the larger ones. The objective is to move all the disks from A to C (using rod B in the process), obeying the following rules:
   1. Only one disk can be moved at a time.
   2. Each move consists of taking the upper disk from one of the rods and placing it on top of another rod i.e. a disk can only be moved if it is the uppermost disk on a rod.
   3. No disk may be placed on top of a smaller disk.



Tower Of Hanoi

A            B            C
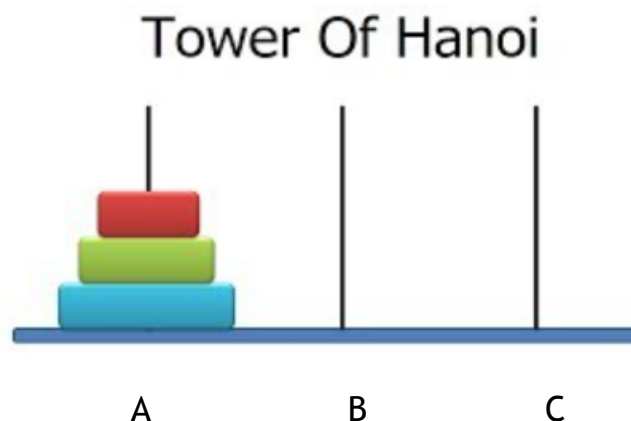
7. Write a program to solve the eight queens problem where we have to place eight chess queens on an 8×8 chessboard so that no two queens attack each other. i.e., no two queens can share the same row, column, or diagonal.

Sample Input:                    Sample output:
N = 4                            0,  1,  0,  0
                                 0,  0,  0,  1
                                 1,  0,  0,  0
                                 0,  0,  1,  0

8. Write a program to count all possible ways of selecting R different objects from N given objects (where R<=N). Note that order of the selected objects does not matter.

Sample Input:              Sample Output for
N = 10                     45
R = 2